Scanning Overview

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published by: HAYWOOD + SULLIVAN

The Scanner as an Input Device

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The scanner is simply a gadget for getting images into your computer. That's it. But as you probably know, getting good images from your scanner requires more forethought and expertise than simply scanning them into your computer.

For one thing, getting good results requires knowing how to correct images with the tools in an image-editing program. However, this book is not about image manipulation techniques, per se. (If you want to become a Photoshop wizard, please see the appendix for a list of supplementary literature.)

Plus, you'll find that not all images can be "fixed" in an image-editing program. The old saying "garbage in, garbage out" applies to scanned images. It's far better to "fix" images at scan time than to try to fix them later in Photoshop or your favorite image-editing program.

To some degree, great scanned images are also the result of good equipment. This explains why your images don't look as good as the professionally scanned images you see in magazines and brochures. It's clearly due to the high-end equipment that publishers can afford to use.

Although great chefs can usually be found in great kitchens, they can also perform their art under less-than-ideal conditions. Even though you may "only" have an entry level flatbed scanner, you can still achieve stunning results with it.

If you want to make the most of your equipment, optimize your scanning time, and deliver the best possible images, then this book is for you! You'll find your scanner can be a really valuable tool when you know how to get good results from it.

How Scanners Work

The scanner is an electro-optical device that captures image data one line or "scan" at a time, hence the name. Using optics much like a camera's, a scanner moves over the imaging area, called the bed, which is defined by a grid of (x,y) coordinates. Each (x,y) coordinate defines a sample area and the resulting captured image is described in samples per inch (spi).

The Basic Components of a Scanner

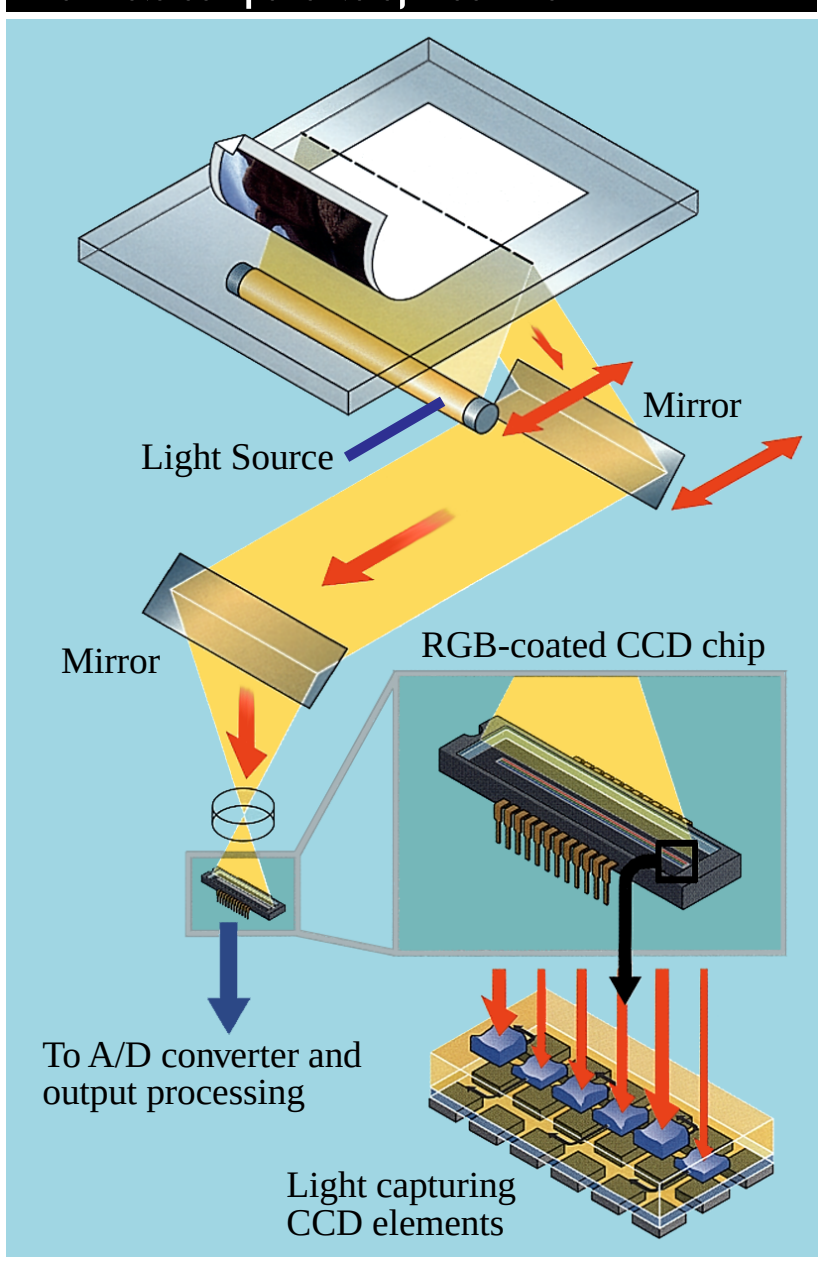

Diagram courtesy of Agfa Division, Bayer Corporation.

Each sample is exposed to a light source of a known intensity. The light either passes through (in the case of a transparency) or is reflected from (in the case of artwork) an original. This light then makes its way through the optics of the scanner to a sensor, which converts the light to an electrical charge. The strength of the charge is in direct proportion to the intensity of the light, which is a reflection (no pun intended) of how light or dark the original sample is. The electrical signal is then converted to a digital signal using an analog-to-digital converter. It is this digital information that makes up the data in your scan.

Since each individual scan line must be calculated separately, scanners are not used to capture moving objects — the scanner is not a camera. But you can use a scanner much as you would a camera to capture 3-D artwork.

For more information see 3-D Objects

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The Scanning Process

The following is a basic step-by-step overview of the scanning process:

Step 1: Preview

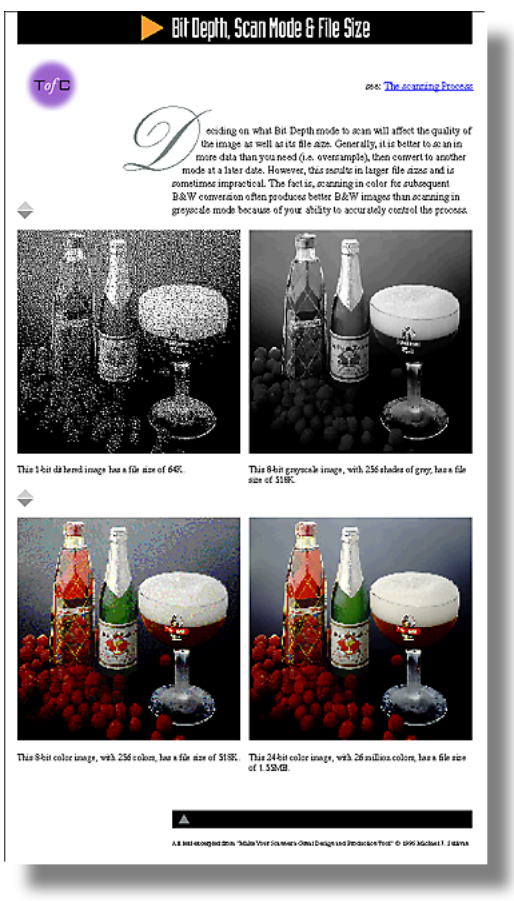
Previewing lets you see a quick, small-scale version of the image before committing to the final scan. At this stage, you also see a frame or marquee around the image. You can adjust this frame so that it crops in on the portion of your image that you wish to scan.

Step 2: Crop to Desired Size and Shape

It's important to crop an image before scanning as opposed to after in your image-editing or page layout program. Cropping at the scanning stage reduces the amount of time needed to scan. Cropping also determines the way your image will look by confining the area in which the scanner's tone controls sense the darkest and brightest areas of the image.

Step 3: Decide on Input Mode: Line Art, Halftone, Grayscale or Color

LINE ART — (also called 1-bit or bitmapped) is the best mode for scanning pure black-and-white originals, such as drawings, logos, signatures, etc. Line art should be scanned at the same resolution as the final output device to obtain maximum detail.


Bit Depth, Scan Mode & File Size

Deciding on what Bit Depth mode to scan will affect the quality of the image as well as its file size. Generally, it is better to scan in more data than you need (i.e. oversample), then convert to another mode at a later date. However, this results in larger file sizes and is sometimes impractical. The fact is, scanning in color for subsequent B&W conversion often produces better B&W images than scanning in grayscale mode because of your ability to accurately control the process.

This 1-bit dithered image has a file size of 64K.

This 8-bit grayscale image, with 256 shades of gray, has a file size of 519K.

This 8-bit color image, with 256 colors, has a file size of 519K.

This 24-bit color image, with 26 million colors, has a file size of 1.52MB.

HALFTONE — (or **DITHERED**) is used for scanning black-and-white photos or color photos to output in tonal gradations from black to white. This mode is a 1-bit format that simulates shades of gray by either creating halftone spots, halftone lines or diffusion patterns. This option is typically used for final output to low-resolution black-and-white laser printers. The high-resolution imagesetters that are found at service bureaus output grayscale images as described in "Step 4". Halftone scans cannot be reverted to grayscale mode.

GRAYSCALE — is the best mode for producing a black-and-white image with a realistic tonal range of grays. Its 8-bit continuous tone configuration produces 256 variations of gray for each sample and provides the greatest flexibility when working with black-and-white images. It's used primarily for producing black-and-white photographs and film negatives.

COLOR — is the mode to select when working with a color image or when colorizing a black-and-white image. Its 24-bit continuous tone configuration produces 256 variations of each of three colors, red, green and blue (RGB), for a total of 16,777,216 possible colors per sample. (256 x 256 x 256). It's used primarily for producing color photographs and slides.

Step 4: Decide on Input Resolution [spi] and Scale

In "Calculate the Right SPI" you'll find tables to help you determine the proper calculations needed for optimal spi/scale settings. However, here are some general guidelines you can follow for the various input modes.

LINE ART — Output should be a multiple of the sample rate because the imaging data is sent directly to the laser printer or to the imagesetter's image engine. A 300-dpi laser printer needs line art at a resolution of 300-spi or 150-spi (a multiple of 300). For output to a 1,200-dpi imagesetter, scan at 300, 600 or 1,200-spi. You are limited in scaling this image in a page layout program if the resolution of the scaled image is not a multiple of the final dpi output. But the obvious advantage of using line art mode is that it produces a much smaller file than an image scanned in grayscale or color mode.

For more information see Scanning Fine Line Art

NOTE: For permanently archiving grayscale and color images, scanning at the highest possible resolution (300 to 600-spi or more) is advised. You can resample the image to a lower resolution in an image-editing program when the image is retrieved.

GRAYSCALE — An spi setting of 1.5 to 2 times output frequency is usually the maximum you should scan. For example, a grayscale image that will be output to 150-lpi (regardless of the output resolution of the laser printer or imagesetter) should be scanned at 225 to 300-spi.

COLOR — As for grayscale, an spi setting of 1.5 to 2 times output frequency is the maximum you should scan. Because an RGB color file is three times the size of the same version of the image scanned in grayscale mode, keep the image resolution as low as possible without compromising quality.

The right scanning resolution and scale for an image also depend on its ultimate destination.

HIGHEST RESOLUTION SAMPLING — As mentioned before, scanning at a high resolution is important when archiving an image. You should also scan at a high resolution when outputting an image on a larger scale. For example, a 600-spi scan delivers 300 samples per inch when output at 200 percent of its original size. Conversely, a 300-spi scan delivers 600 samples per inch when output at 50 percent of its original size. Ultimately, your computer's power and speed determine how large a file you can work with. An 8" x 10" color image, scanned at 300-spi (a 2-to-1 sample rate) for 150-lpi output at 1,200-dpi results in a 21.6MB file. Not every computer can handle files this big!

OPTIMAL RESOLUTION SAMPLING — This sampling gives the best possible results for your image's output destination at a resolution that doesn't result in an enormously large file. You can figure out what the optimum scan resolution should be when you know exactly what size your scanned image will be for final output. For example, a color 8" x 10" image scanned at 100 percent using a 1.5-to-1 sample rate for 133-lpi output (200-spi) results in a more manageable 9.6MB file. When printed at the same size, the quality of this 200-spi image is more than adequate for most printing applications.

FPO SAMPLING — These are low-resolution images used for position only that will be replaced with a much higher resolution version of the same image at a later time. They require a minimum amount of memory, meaning they are faster to work with and easier to store than high-resolution images. A typical sample rate is 72-spi, which matches most screen resolutions. A color 8" x 10" image scanned at 72-spi results in a mere 1.2MB (24-bit color) or 414K (8-bit color) file size.

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Step 5: Adjust Tone Controls

NOTE: For dark originals where there is the likelihood of noise generated by the scanner, it is advisable to selectively sharpen light regions after scanning.

Your tone controls depend on your particular software/hardware combination. The names for the various tone controls and how they perform are not consistent from program to program. For example, some programs use the term *lightness* for gamma (midtone lightness), whereas others use gamma for overall lightness. Unfortunately, you can only determine how to adjust tone controls on your scanner by reading and understanding your user's manual or calling the manufacturer's technical help line.

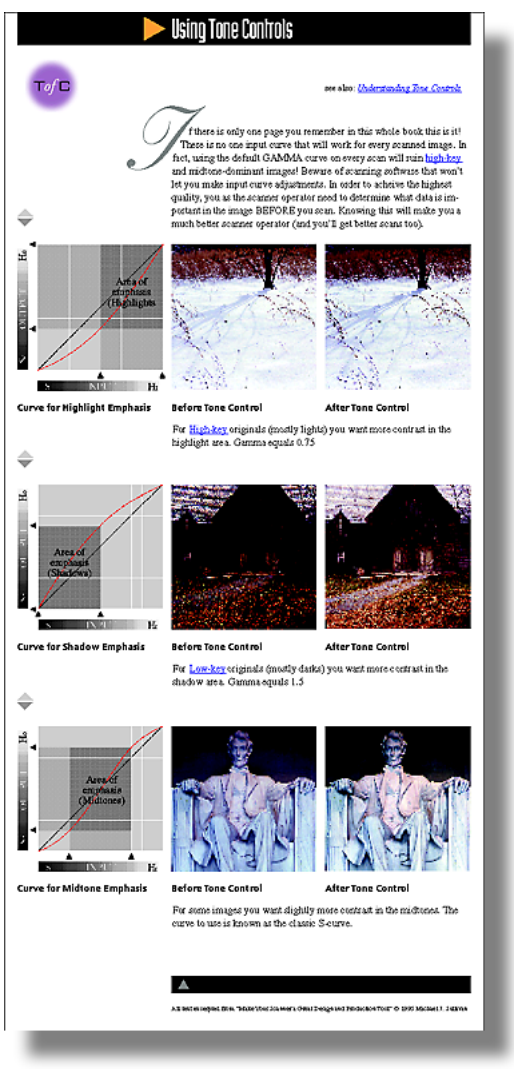
Typical setting choices include:

DMIN/DMAX — These are density settings that use a logarithmic scale from 0 to 4, where 0 equals pure white and 4 equals pure black. (Most scanners limit you to about 0.1 Dmin to 3.2 Dmax.) Choose the maximum density (Dmax) and the minimum density (Dmin) for the data in your image to map to. This setting is similar to Set White Point/Set Black Point, described below, except that it allows you to set the controls numerically.

SET WHITE POINT/SET BLACK POINT — This option lets you choose precisely which samples or portions of the image will map to pure white and pure black. All other colors will fall between these two extremes. A nice feature that comes with some applications allows you to remove any color cast in the white/black sample point as well.

EXPOSURE — This option is especially useful when working with very dark originals where the scanner may not "see" details in shadowed areas. However, very few scanners actually support this feature. Thus, if you see this option, be suspicious — it might really be just a linearized lightness control.

LIGHTNESS — You should probably avoid using this control if your scanning software offers it unless, of course, this is your scanner manufacturer's terminology for gamma or midtone brightness. Technically, lightness is a linearized "curve" that increases overall lightness by cropping out key data in a highlight region of the image. (I'll explain more about linear adjustments later in this chapter.)


Using Tone Controls

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see also: Understanding Tone Controls

If there is only one page you remember in this whole book this is it! There is no one input curve that will work for every scanned image. In fact, using the default GAMMA curve on every scan will ruin high-key and midtone-dominant images! Beware of scanning software that won't let you make input curve adjustments. In order to achieve the highest quality, you as the scanner operator need to determine what data is important in the image BEFORE you scan. Knowing this will make you a much better scanner operator (and you'll get better scans too).

Curve for Highlight Emphasis | Before Tone Control | After Tone Control

For High-key originals (mostly lights) you want more contrast in the highlight area. Gamma equals 0.75

Curve for Shadow Emphasis | Before Tone Control | After Tone Control

For Low-key originals (mostly darks) you want more contrast in the shadow area. Gamma equals 1.5

Curve for Midtone Emphasis | Before Tone Control | After Tone Control

For some images you want slightly more contrast in the midtones. The curve to use is known as the classic S-curve.

CONTRAST — You should probably avoid using this control as well. Technically, contrast is a linearized "curve" that increases midtone contrast by cropping out key data in the highlight and shadow regions of the image.

GAMMA — Gamma is also known as midtone brightness. With 1.0 as the median for an image's midtones, adjusting the gamma to 1.5 lightens the midtones of an image while a gamma setting of 0.75 darkens them.

TONE CURVE — Customized tone curve adjustments go beyond simple gamma controls. When you adjust the tone curve of an image you're adjusting the concentration of tone detail. See Using Tone Controls.

IMPORT TONE CURVE — This is probably the most powerful feature for adjusting tones (if your scanner offers it). Using this option allows you to import a tone curve from an image-editing program that optimizes the way in which the scanner captures the data from an original.

HISTOGRAM — This control shows a chart that depicts, on a scale of 1 to 256, the number of instances within an image where one of 256 shades of gray appears. It is a "snapshot" of the distribution of data within your image. Thus, dark (low-key) images have most of the sample points skewed to the left, while light (high-key) images have most of the data samples skewed to the right.

Step 6. Choose Other Options

Some scanner/scanning software combinations offer Sharpening, Descreening and other controls. It is usually more efficient to take advantage of these options at scan time rather than doing them later.

Step 7: Scan

The time involved in scanning depends on the size of the scan (determined by the overall resolution and bit depth), the speed of your scanner, SCSI bus and computer. Scanning used to be fairly time consuming; however, newer scanners and computers are more than twice as fast as yesterday's models. Even 20MB images may now appear on your screen in a matter of seconds.

Step 8: Save

NOTE: It won't be long before multitasking computers will be widely available. They'll enable you to do several functions, such as scan, print, save, use a modem and lay out pages, at the same time.

Do this now, before you make any changes! You may want to revert back to this original later.

Here are your options:

- Save in proprietary Photoshop native format if you want to work with the image in this program. While Photoshop native format can't be opened by desktop publishing programs, it is run-line encoded (RLE) for compact file size and it offers the ability to save alpha layers, masks and clipping paths with the file.
- Save as a PICT or BMP file if you want to use the image as is for computer display. Many multimedia programs such as Macromedia Director, Apple Media Kit and HyperCard only work with PICT. BMP and PICT images can also be imported as templates for autotracing in illustration programs.
- Save in TIFF or EPS, the most popular file formats for desktop publishing. TIFF images can be imported into page layout programs. EPS files are used when a clipping path and/or CMYK separations are used.

Personally, I prefer to save the original scan in Photoshop format; that way, I know it's the "original." Only after I have scaled the image to its final size and made other adjustments for maximum printability, do I save the image, using a different name, as a TIFF, EPS or PICT file as appropriate.

Step 9: Clean Up Image in an Image-Editing Program

NOTE: This work is time consuming but very valuable. You should work at the highest resolution your equipment can handle. Resample your image down to a more convenient size later.

At this stage you should remove dust eliminate scratches selectively brighten and or darken, remove noise, resize, crop further, color correct, soften, sharpen, etc.

Step 10: Save Again

Save this image with a different name so, if necessary, you can go back to the original scan at a later date. Of course the downside of saving two images is that you have two versions taking up valuable storage space on your hard disk.

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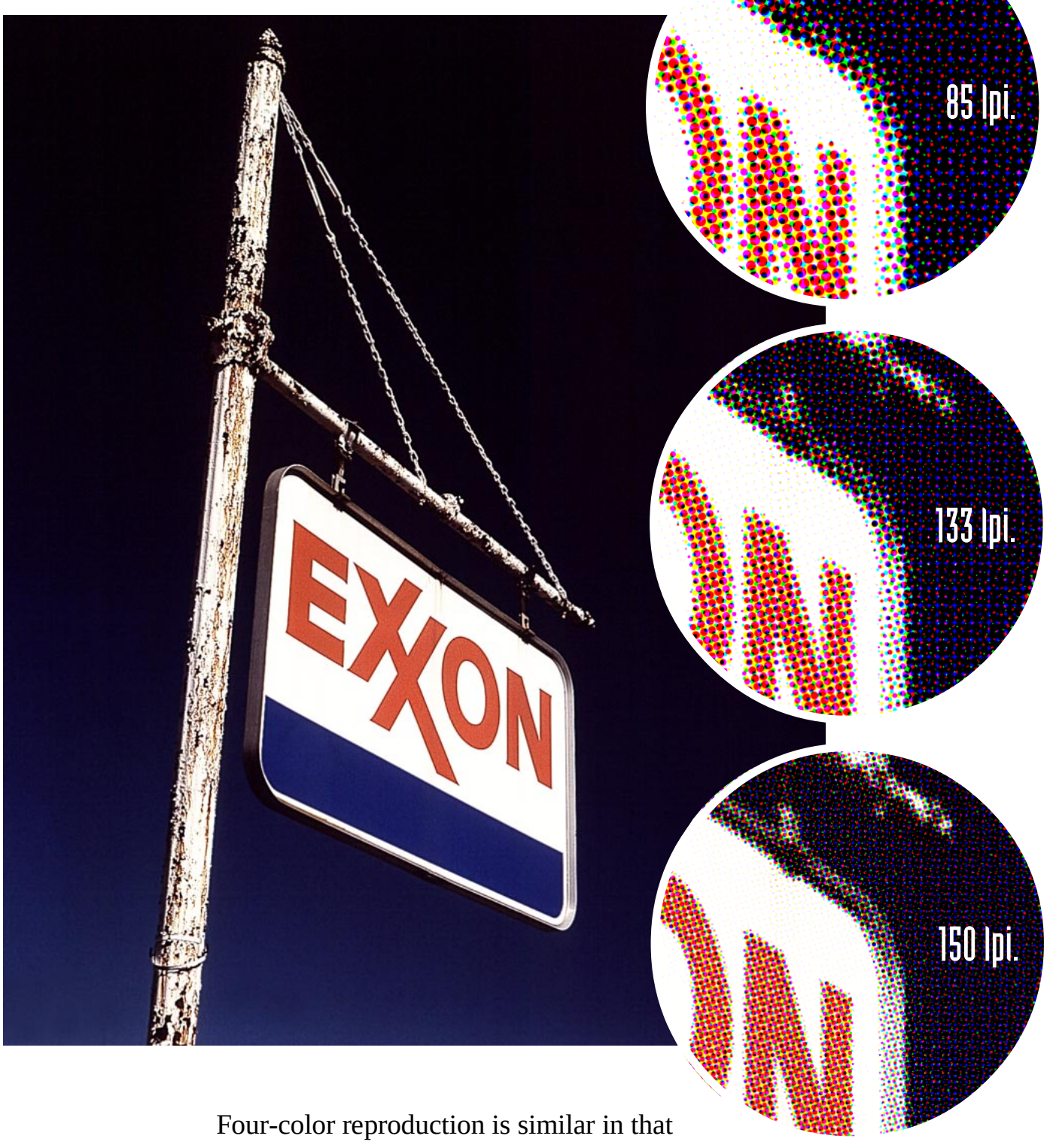
Halftone screens came about as a way to print, in four-color and in black-and-white, the tone gradations that appear in photographs and illustrations. Halftone screens consist of many spots in varying degrees of concentration. In black-and-white or one-color printing, the concentration of spots is 100 percent for solid black or a solid area of color. A white area, or area of no color, is represented by a spot concentration of 0 percent. The range of spot concentration in between varies from 1 percent in the lightest regions of an image to 99 percent in the darkest.



Four-color reproduction is similar in that the four process colors (cyan, magenta, yellow and black) are combined in spots of various concentrations to yield an array of colors and tones. Each color in a printed image is the result of a blend of four halftone screens — one for each of the four process colors.

In the reproduction of digital images, three factors need to be taken into consideration:

- The image's output resolution as defined by the number of dots per inch (dpi). 300-dpi is typical of laser printer output to plain paper whereas service bureau imagesetters typically output images on photosensitive paper or film at a resolution of 1,200 or 2,400-dpi.
- Spot concentration, ranging from 0 to 100 percent as explained earlier.
- Halftone or screen frequency as measured in lines per inch (lpi). This term may seem confusing because it doesn't describe lines per se, but rather the number of rows of spots that make up a half tone screen. The lower the frequency or number of rows, the coarser an image appears. Conversely, the higher the frequency, the more refined the image is.

Clearing Up the Confusion Among spi, dpi, lpi and ppi

dpi? lpi? ppi? spi!

Basic to understanding scanning and printing images is a knowledge of the terminology involved. As I researched other resources for this book, it became clear to me that no one in the industry was consistent in using terms to describe the resolution of scanned images. Many publications use the term dpi to describe the scan data, only to use the same term to describe the resolution of the output device — inconsistent and confusing, to say the least. Others use the term ppi (pixels per inch) to describe scanned data — a term that is also used to describe a computer's screen resolution.

In this book I have chosen to use the term spi (samples per inch) to describe the scan data. In essence, spi is the input frequency used when scanning the original. I also use the term to describe the frequency of the sample data when an image is scaled at output time. For example, although an image may be scanned and saved at 300-spi, when it is scaled to 50 percent of its original size in a page layout program, its effective sample frequency becomes 600-spi.

Because samples are not the same as laser printer dots, halftone spots or computer screen pixels, all other such prepress and desktop publishing terms (such as dpi, lpi and ppi) are used to describe output.

For more information see Choosing the Best Screen Frequency

Definition of Terms

Term	Meaning	Description	Typical Measurement
SPI	Samples Per Inch	Input Frequency of Scanned Image	300-600 spi (flatbed) 1850-3600 spi (slide)
DPI	Dots Per Inch	Resolution of Imagesetter (output)	300-2400 dpi
LPI	Lines Per Inch	Halftone Frequency for Printer (output)	133-40 lpi
PPI	Pixels Per Inch	Resolution of Computer Screen (output)	65-96 ppi

This chart defines the various terms and typical output frequency for each.

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Scanning for Output Method

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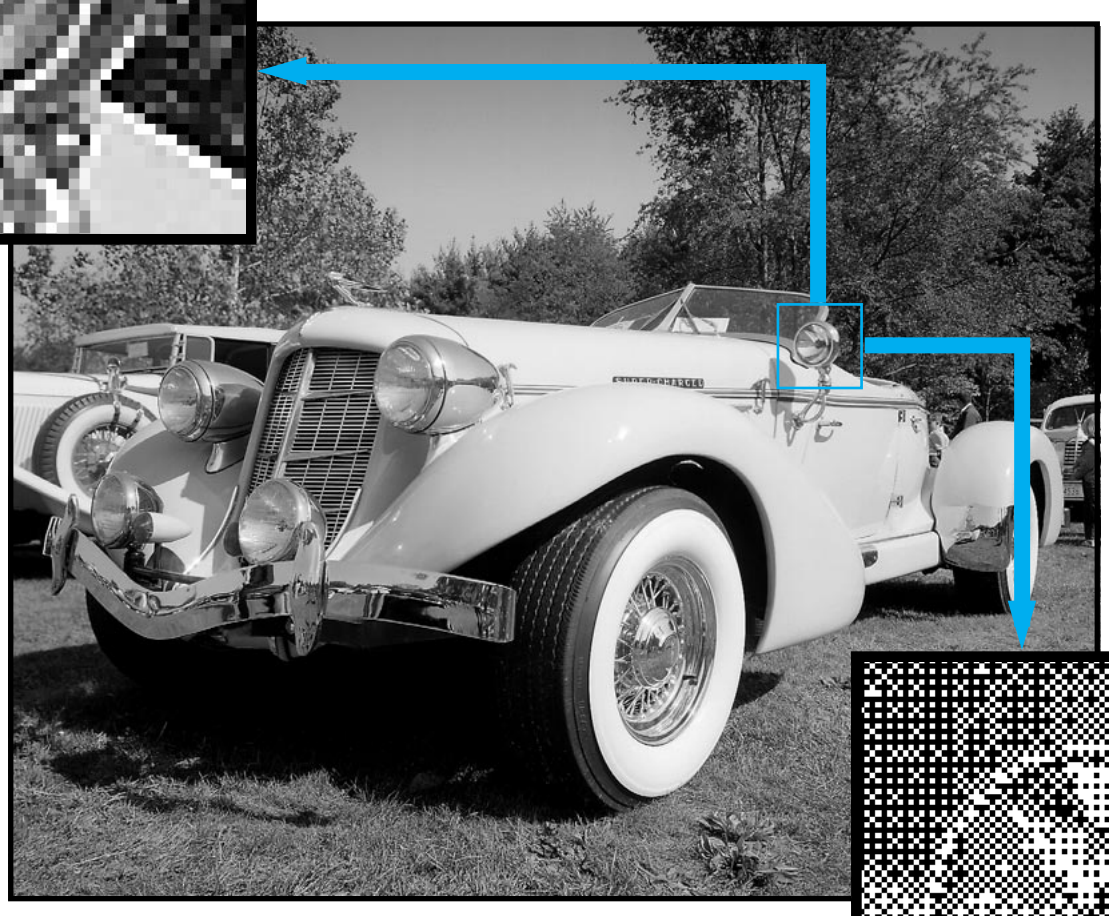
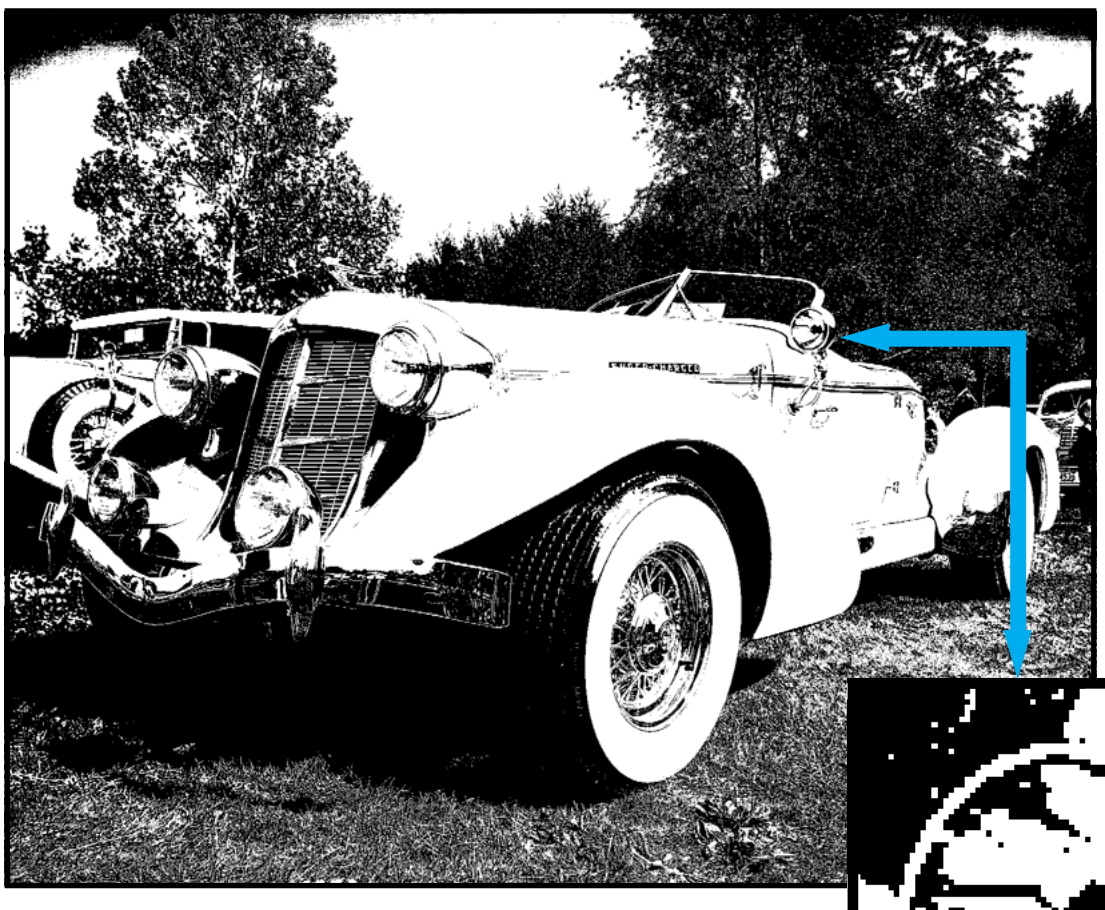
When scanning, you always have the choice of what kind of image you want to capture. For line art, you would usually choose 1-bit mode (although there are times when it is better to scan using 8-bit mode.) For B&W photographs, you generally would scan using 8-bit mode. There are times, however, when you may want to scan a photograph in Halftone (also known as Dither) mode — especially when outputting to low resolution laserprinters as the final artwork.

Scanning in **Grayscale or 8-bit** gives you the most flexibility, since you can always later output using dithered or threshold methods, if necessary.



Halftone or Dithered scanning refers to a 1-bit mode where the effect of continuous tone is achieved using a dithered pattern of small black dots representing various shades of grey. The advantage is smaller file size, and in some cases, sharper-looking images.



Threshold or Bitmapped scanning is useful when you want the unique look of a high contrast image. Many designers use this effect for backgrounds and other graphic shapes in their designs.

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Bit Depth, Scan Mode & File Size

see: The Scanning Process

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This 1-bit dithered image has a file size of 64K.

This 8-bit grayscale image, with 256 shades of gray, has a file size of 518K.

This 8-bit color image, with 256 colors, has a file size of 518K.

This 24-bit color image, with 26 million colors, has a file size of 1.55MB.

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Optimal Resolution Sizing (for print)

Equivalent to approximately 4 inches

292 k

This 72-spi image works fine as an FPO image and has a manageable file size.

1.24 mb

This 150-spi image scanned at a scale of 100 percent from a 5" x 7" chrome yields an image that doesn't hold as much detail as you generally want from output to print.

2.78 mb

This 225-spi image was scanned at 100 percent. This combination of scaling and resolution produces this best image for output to print.

4.94 mb

This 300-spi image was scanned at 100 percent. This combination of scaling and resolution is best when archiving an image.

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Understanding Tone Curves & Histograms

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I know it may seem intimidating, but you need to understand tone curves to produce anything beyond mediocre scans. Even professionals get confused by the complex interfaces found in powerful scanning and image manipulation programs. But don't fret. It's really rather simple.

All image manipulation and scanning tools have one thing in common: They all depict, and thus provide an interface to, the mapping of an input sample to a corresponding output sample. The classic method is a tone curve as shown in Figure 1.

An alternative (and complementary) tonal correction method is the histogram. Histograms depict the distribution of tones within an image. The legend depicts the relationship between each input tone and its corresponding output tone.

Key:

S_i = Shadow dot (input)
H_i = Highlight dot (input)
B = Midtone brightness
C = Contrast (angle of curve)
S_o = Shadow dot (output)
H_o = Highlight dot (output)

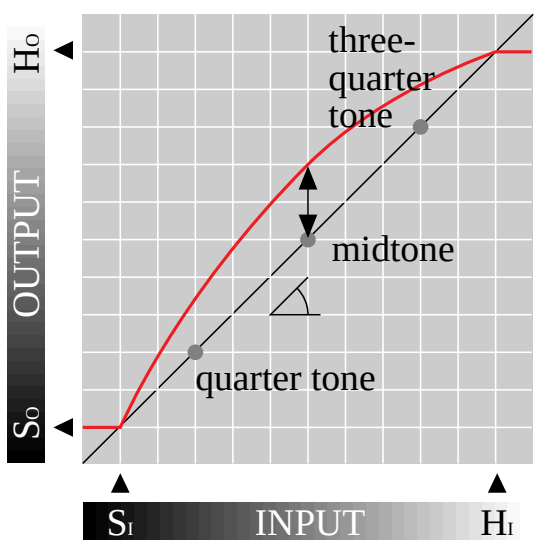

Figure 1: Tone Curve.

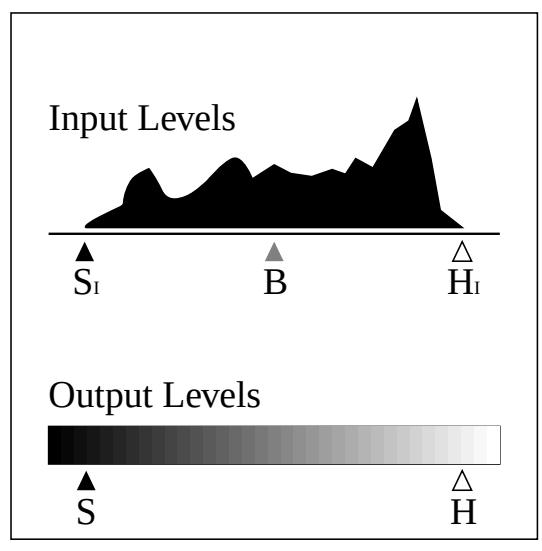

Figure 2: Histogram.

The key thing to remember is that tone curves and histograms do the same thing — map input tones to output tones. The difference is that histograms give you visual feedback, providing information on tone distribution within the image. Unfortunately, histogram adjustment is rare in scanning software — most programs just offer tone controls.

Tone Curves Made Easy

In theory, input should match output one-to-one. But that's theory. In reality, most desktop scanners can't reproduce shadow detail correctly — they simply don't have enough "vision" to see into the darker portions of an image. Thus, most desktop scans lack shadow detail and are generally too dark.

Mastering nonlinear tonal corrections, also known as gamma correction, is really a matter of bringing out the detail in the dark areas of an image and adjusting the tone range to compensate for darkness.

The key to bringing out the detail in the dark portions of an image is in increasing the contrast in that area. The more contrast you have in any given area of an image, the more differentiation there is between shades of gray — resulting in the perception of both more detail and emphasis in that area.

The degree of steepness in a tone curve corresponds to the degree of contrast. But there's a catch — you can't have a steep curve everywhere in an image! Every steep or high contrast area needs to be offset by a shallow or flat area. This is a zero sum game, people.

Likewise, you don't always get the best results if you adjust the tone curve setting on your scanner to a perfectly straight 45° angle, which represents an exact one-to-one mapping. Almost all images need some "help." Some images have important detail in the shadow areas, some have important detail in the highlight region, and some have midtone emphasis. Some images are too contrasty, some too flat, some too light, some too dark.

There are two reasons why it's far better to achieve an optimal tone curve at scan time than to manipulate the image later. First, it takes less time to scan an image correctly than to scan it poorly and adjust or manipulate it later. Second, every time you manipulate an image, you lose some data, even if just a bit. The cumulative effect of too many post-scan image manipulations is an image with less data.

To achieve the best results, keep the contrast angle steep for the most important areas of the image. There is no one formula that works best for all images. Your understanding of this fact already makes you a much better scanner operator!

Linear Corrections A Major Post-Scanning Mistake

Fortunately, most scanning applications don't provide brightness and contrast controls, both of which are examples of linear correction. A linear correction, as the name implies, adjusts the default tone "curve" (a straight line) up and down or changes the angle of the line. In the post-scanning environment, using linear corrections is a no-no — you lose important data. More specifically, adjusting brightness shifts the tone line straight up. Data is lost in the highlights and simply disappears.

Contrast adjustments perform in a similar, linear manner. Although detail in the midtone grays is improved, the original input shadow detail is mapped to pure black, resulting in permanent data loss.

Film vs. Paper Output

Paper output halftones are typically limited to about 110-lpi. This is because paper originals must be photographed by the printer in order to make film negatives and then plates for the printing press. When photographing the original, some detail is lost, particularly the small dots in the lighter regions of the image.

Outputting to film eliminates a step because film negatives are used to make the plates. Consequently, very small dots can be used. In general, you should output to film negatives (or film positives for processes such as silk screen) whenever possible. They give the best results.

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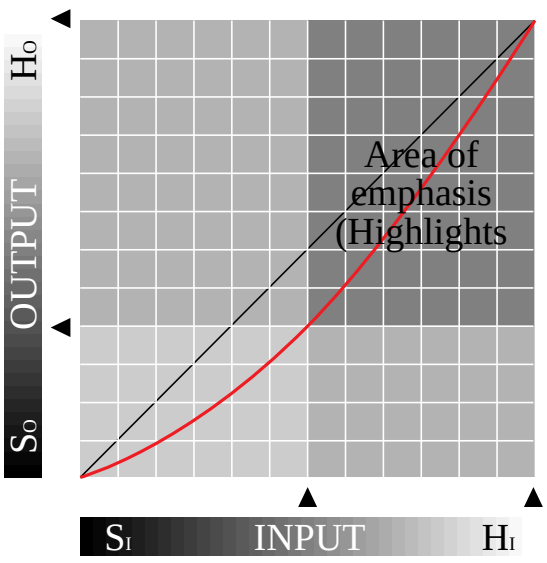
Using Tone Controls

see also: Understanding Tone Controls

If there is only one page you remember in this whole book this is it! There is no one input curve that will work for every scanned image. In fact, using the default GAMMA curve on every scan will ruin high-key and midtone-dominant images! Beware of scanning software that won't let you make input curve adjustments. In order to acheive the highest quality, you as the scanner operator need to determine what data is important in the image BEFORE you scan. Knowing this will make you a much better scanner operator (and you'll get better scans too).

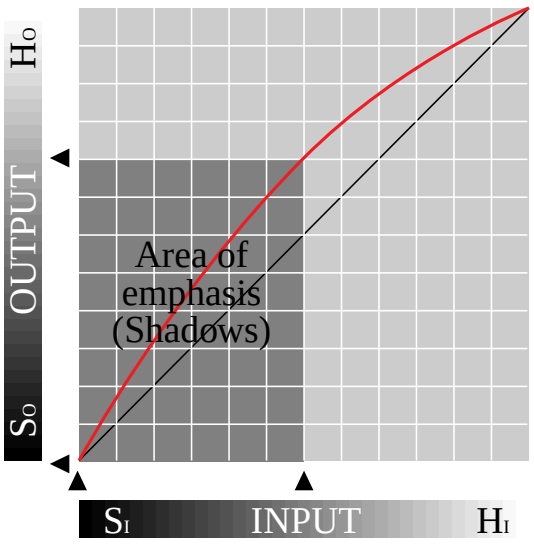


Curve for Highlight Emphasis

Before Tone Control

After Tone Control

For High-key originals (mostly lights) you want more contrast in the highlight area. Gamma equals 0.75

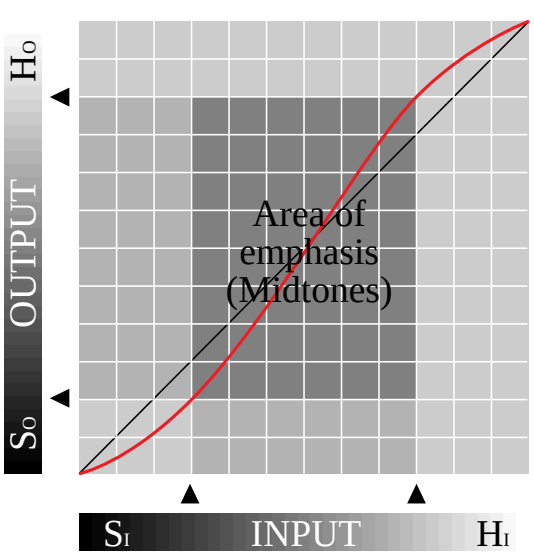


Curve for Shadow Emphasis

Before Tone Control

After Tone Control

For Low-key originals (mostly darks) you want more contrast in the shadow area. Gamma equals 1.5



Curve for Midtone Emphasis

Before Tone Control

After Tone Control

For some images you want slightly more contrast in the midtones. The curve to use is known as the classic S-curve.

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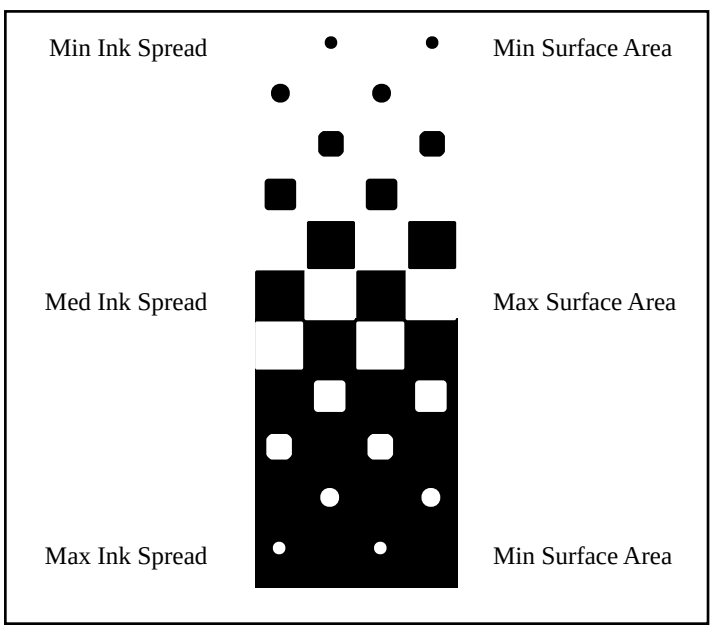
Dot Gain — or Spot Variation

Scanning for a computer monitor is easy. A 24-bit monitor can faithfully reproduce every sample in your scanned image. However, if your image looks just right on your computer monitor, it will probably print too dark on press. This is due, in part, to the inability of the four process inks (cyan, magenta, yellow and black) to exactly reproduce every color in the spectrum. It's also due to the fact that ink spreads beyond the perimeter of the halftone spot when it is applied to paper, a phenomenon known as dot gain.

The amount of this spread is affected by the absorbency of the paper and the surface area of each individual spot. The porous surface of uncoated paper absorbs much more ink than the smooth surface of a coated paper, causing the ink to spread more, although even the shiniest of coated papers exhibits some dot gain. On an uncoated sheet, the darkest gray or shade of any color you can use without losing detail varies from an 88 percent to 95 percent tint.

Spots with greater surface area tend to exhibit more dot gain. This is especially true in areas with adjacent square halftone spots — ink tends to bridge the gap between spots, creating even greater dot gain. For this reason midtone spots generally spread more than either highlight or shadow spots.

Factors Affecting Spot Gain



An altogether different problem occurs when printing the lightest tints in an image. You see, a 5 percent spot at 150-lpi is extremely small. On press, anything smaller than this will probably not print. The combination of factors involved in offset lithography — water, blankets and offsetting — make it hard for very small dots to hold ink.

The net effect is that an image that looks "right" on your computer monitor (unless your monitor is specially calibrated for offset printing) does not print well on press. Usually, it exhibits loss of detail in shadow regions, highlight regions drop out and midtones are "muddy" — yuck!!

Thus, for printing you should prepare an image so that its maximum and minimum spots are as depicted in the Screen Guidelines for Optimum Halftone Output chart. You may also want to set gamma (or midtone lightness) an additional 1.2 to lighten the midtone dot for most presses.

Screen Guidelines for Optimum Halftone Output

Paper	Min. Tint	Max. Tint	Min. Output Level (on a scale of 0-256 in Photoshop's levels dialog)	Max. Output Level
Coated	5%	95%	12	243
Uncoated	10%	90%	25	243
Newspaper	12%	88%	30	225

You can specify these tints when you scan if your scanning software supports it. Or you can adjust these settings in an image-editing program such as Photoshop after you scan by using the Levels command. Simply open the Levels dialog box (Command-L in Photoshop), type in the appropriate numbers for shadow output (S_O), highlight output (H_O) and midtone lightness (B) (consult Screen Guidelines for Optimum Halftone Output). Click OK and save as a new file name. The image on your screen may look somewhat washed out, but rest assured, it will give you optimum results on press.

I prefer to scan at full tonal range, since much of my scanning work is also used for multimedia purposes. Then, when I go to print, I modify the image file as appropriate for the intended output/paper combination and dot gain. I then save the modified image with a new file name. This way I have two versions of the image: the "screen" or master version that looks just the way I want it to look and the "print" version.

NOTE: Some color separation software is now able to perform dot gain on the fly at imagesetting time — check with your service bureau to see if they can provide this service for you.

How Paper Affects an Image

As mentioned earlier, the quality of an image is affected by the type of paper on which it is printed. Your paper choice dictates the maximum printing screen frequency (lpi) you can achieve, and the lpi you select affects the spi setting to use for your image file.

In general, use an spi setting from 1.5 to 2 times the printing screen frequency (lpi). Low-resolution scans should be used for 300-dpi laser output where more data won't improve the resolution of an image. On the other hand, high-resolution offset printing on coated stock demands a scan at a much higher spi setting, resulting in a correspondingly larger file.

For more information on additional sources explaining dot gain, prepress issues and printing standards see appendix.

The Best Screen Frequencies by Output

Printing Method	Paper Used	Screen Frequency	Scan@ 1.5 to 1
Xerographic copier	Laser paper	50-75 lpi	75-125 spi
Quick print (paper plates)	Uncoated	50-75 lpi	75-125 spi
	Coated	75-110 lpi	125-175 spi
Offset Lithography	Uncoated	85-133 lpi	125-200 spi
	Coated	120-175 lpi	180-300 spi

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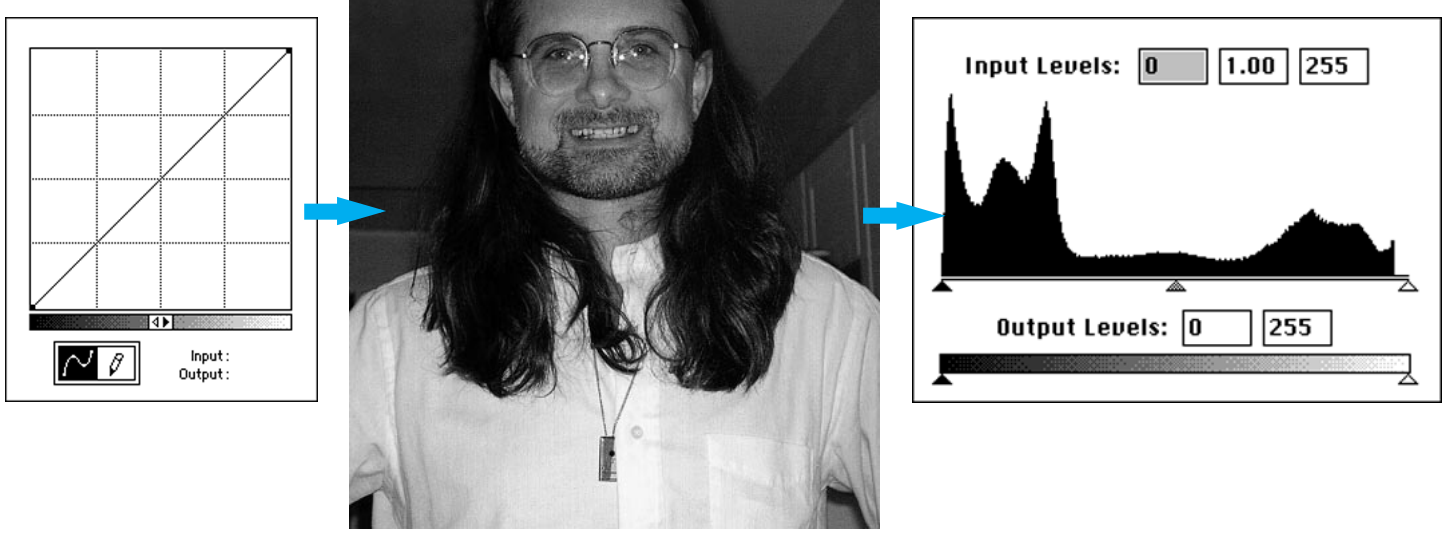
What Not to Do: Making Linear Adjustmants

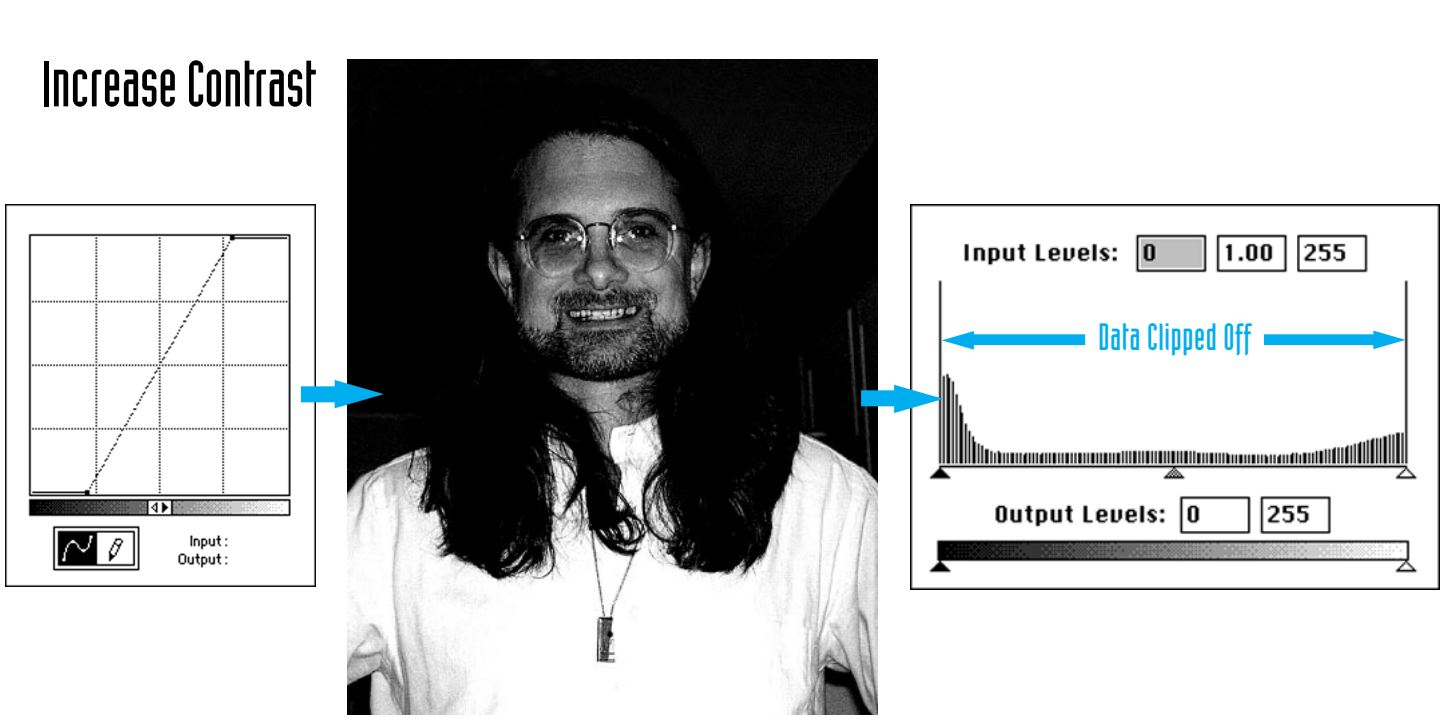
ToC

Never, ever use linear controls that increase contrast, darkness, or lightness! As clearly demonstrated in the images below, you'll permanently lose data (besides, the results are simply too harsh). Instead, utilize the curves command by gently adjusting the curve to achieve a smooth tonal range. In that way you'll acheive much better scans.
See Using Tone Controls.

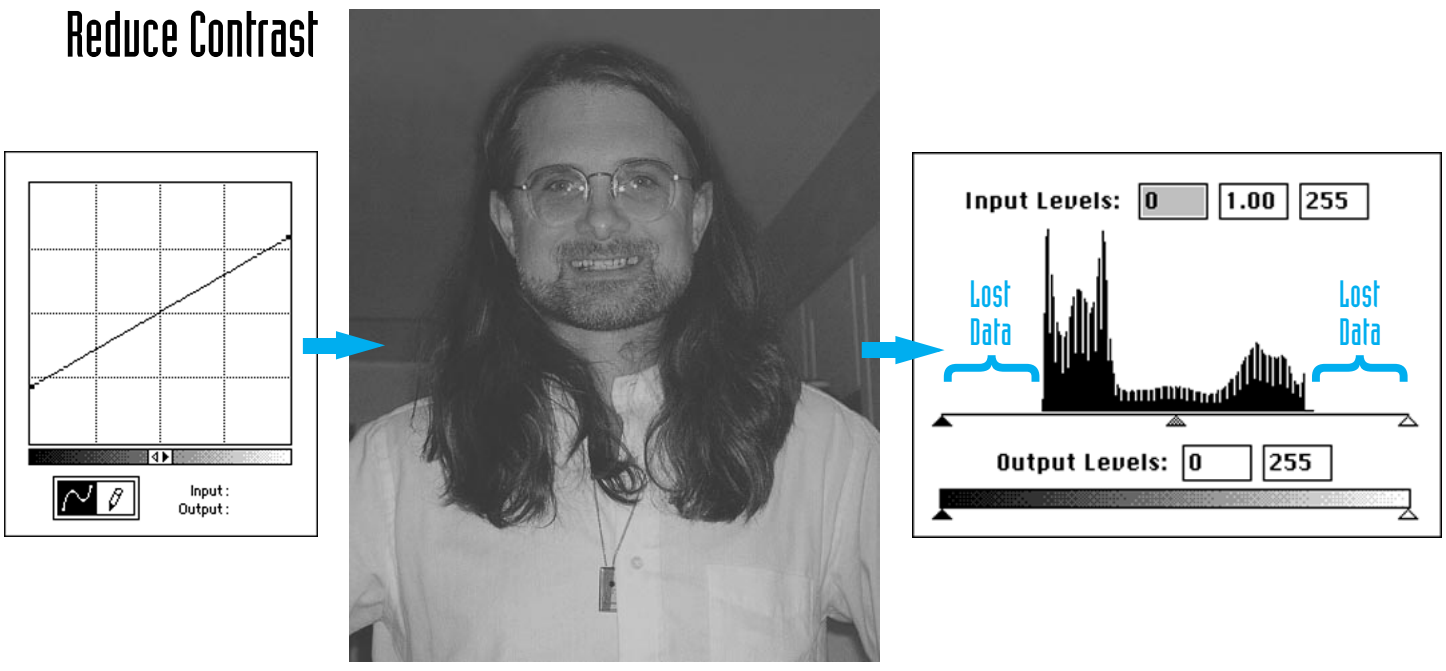
Original Scan



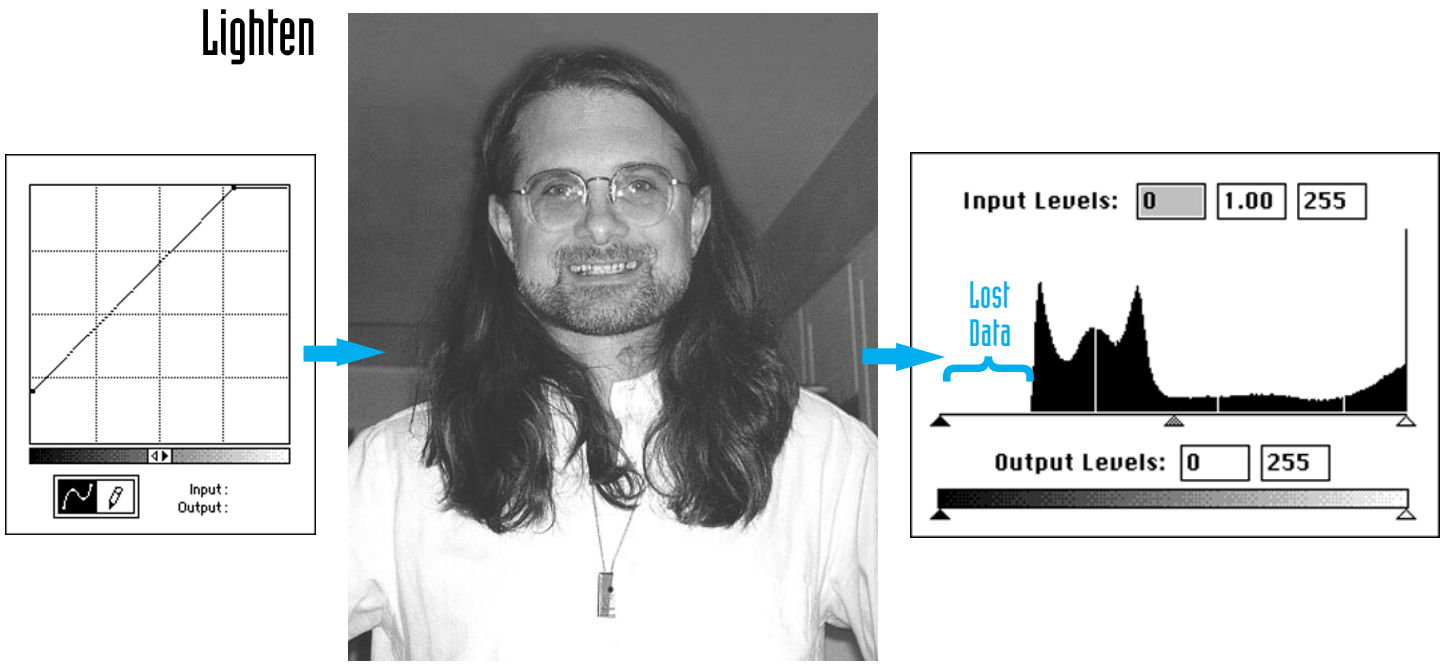
Increase Contrast



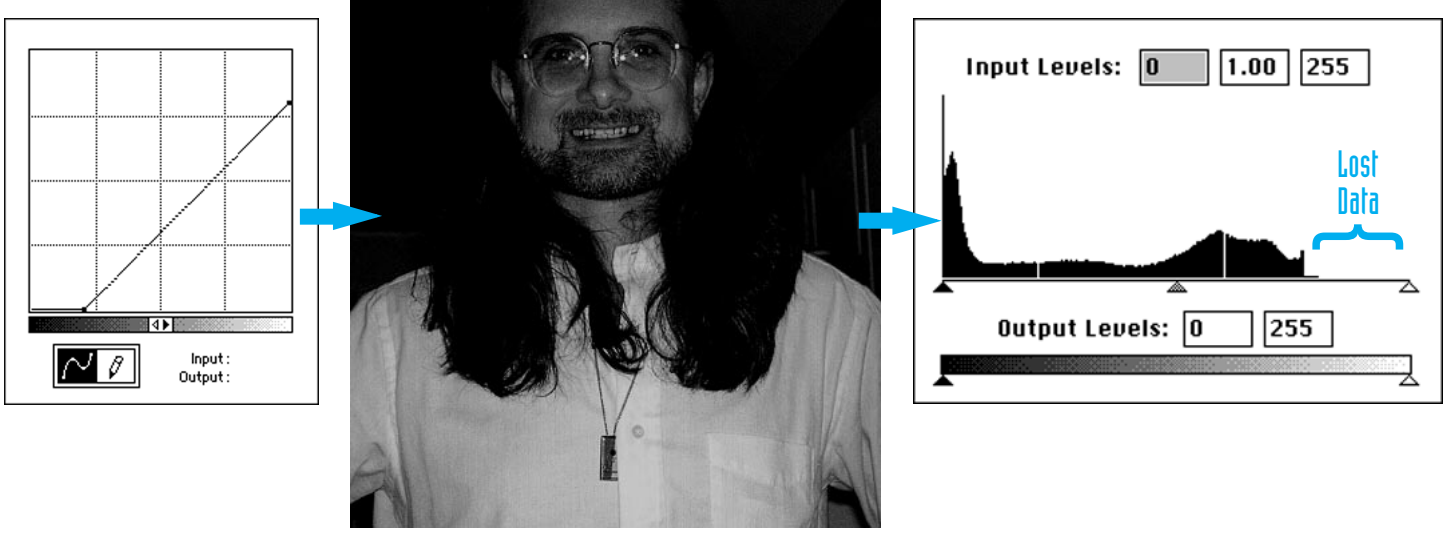
Reduce Contrast



Lighten



Darken



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TofC

Needless to say, scanning images takes lots of hard disk space. And unless you have terabytes of free space, sooner or later you have to deal with where to put all this neat stuff.

I prefer to scan at the highest resolution first, manipulate the image to remove dust and scratches, do some minor color correcting, and archive the (large) file to magneto-optical or DAT backup. I then make an optimally sized image for my intended use by resizing down. At this time I apply sharpening and any other image manipulation as necessary. All this takes place on a (mostly) clean 1.2GB fast hard disk.

Nevertheless, I often find myself swamped with hundreds of megabytes of images in no time flat. For this reason I prefer 1.3GB magneto-optical (MO) drives. I have one disk for each of my clients and their respective projects. Occasionally, I need one MO drive for just one project! Even then, I make DAT backups of the whole enchilada, in case I lose or damage my MO drives.

It goes without saying that you also need a large hard disk to work on your active projects. Photoshop not only works best with a lot of RAM but also needs a lot of free hard disk space. Therefore, it's important to keep your main hard disk clean most of the time. Backing up your files on a daily basis (weekly at the very least) is of utmost importance.

I have outlined a few of the more popular large storage media available. Unfortunately, prices change monthly. Use this chart as a rough comparison only. But remember, you should choose media that will be compatible with others as well. Call your service bureaus or other vendors and ask them what they use. Most people will gladly give you their opinion (just take it with a grain of salt!).

Storage Media: Find the Best Option for Your Needs

Type	Size	Drive Cost	Media Cost	Access Time	Throughput
Syquest	44mb	$200	$45/disk	30ms	1mb/sec
	Remarks: Popular with service bureaus Low cost for drives, high cost per megabyte for media				
Syquest	88mb	$300	$55	30ms	1mb/sec
	Remarks: Compatible with Syquest 44 Low cost for drives, high cost per megabyte for media				
Syquest	105mb	$299	$100	15ms	17mb/sec
	Remarks: Compatible with 3.5" media Not quite as universal of other Syquest types Low cost for drives, high cost per megabyte for media				
Syquest	200mb	$800	$90	30ms	1mb/sec
	Remarks: Compatible with Syquest 44 and 88 Low cost for drives, high cost per megabyte for media				
Hard disks	1.2gb +	$399	NA	9.8ms	4.3mb/sec
	Remarks: Needs backup to be safe SCSI 2 drives can be twice as fast as listed here				
Magneto Optical	128mb	$900	$20	40ms	700kb/sec
	Remarks: Slow writes, fast reads Compact 3.5" media High cost for drives, low cost per megabyte for media				
Magneto Optical	1.3gb	$1700	$85	30ms	1mb/sec
	Remarks: Slow writes, fast reads These drive are really two separate 650mb disks back-to-back				
CD recordable	650mb	$1000	$10	200ms	300kb/sec
	Remarks: Very slow writes and throughput High cost for drives, low cost per megabyte for media				
DAT	1-2gb	$700	$20	varies (depends where file is on tape)	
	Remarks: Requires backup software to access files Lowest cost per megabyte for media				
DAT	4-8gb	$1,000	$20	varies (depends where file is on tape)	
	Remarks: Requires backup software to access files Lowest cost per megabyte for media				
Iomega Zip Drive	100mb	$199	$20	29ms	1.40mb/s
	Remarks: Inexpensive solution for storage.				
Iomega Jazz Drive	1gb	$599	$99	10-12ms	5.4mb/s
	Remarks: Inexpensive solution for storage. Low cost per megabyte.				

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